PEATLAND POCOSINS

Contents

PEATLAND POCOSINS THEME

Concept: Peatland Pocosins are saturated wetlands of Coastal Plain flats, swales, and Carolina bays, with organic matter accumulation (Histosols or histic surface layers), and with distinctive vegetation characterized by *Pinus serotina* and a suite of shrub species. Most of the pocosin shrub suite is evergreen and most are members of the Ericaceae. Vegetation structure ranges from woodlands or nearly closed forests to dense shrublands to treeless herb-dwarf shrub vegetation, with each structure sharing most of these species.

Distinguishing Features: Peatland Pocosins are distinguished by the above combination of characters. The suite of characteristic pocosin species consists of *Lyonia lucida, Ilex glabra, Ilex coriacea, Zenobia pulverulenta, Cyrilla racemiflora,* and *Chamaedaphne calyculata*, along with the vine *Smilax laurifolia*, and the trees *Pinus serotina, Gordonia lasianthus, Magnolia virginiana*, and *Persea palustris*. A couple of communities are dominated by *Arundinaria tecta*. Some combination of this suite dominates, most species are usually present, and few additional woody species are present. A few other communities share dominance by these species but occur in different environmental settings and have additional species characteristic. The most closely related theme, Streamhead Pocosins, shares much of the flora but occurs in seepage-fed drainages in sandhill terrain rather than on flats or in large basins. *Liriodendron tulipifera* and *Toxicodendron vernix* are additional characteristic species. Several Coastal Plain Small Depression communities share many species but occur in small depressions with an influence of surface water flooding and have some additional species such as *Nyssa biflora, Taxodium ascendens*, and several deciduous shrubs. Coastal Plain Nonalluvial Wetland Forests share some of the species but are dominated by different trees and usually have additional shrub and herb species. Wet Pine Savanna communities may be invaded by pocosin shrubs with the long absence of fire, and in the most extreme cases may be difficult to distinguish, but savannas will have mineral soils and generally will have a least a few remnants of savanna species.

Within the theme, communities are distinguished by variation in typical vegetation structure, which reflects a gradient of wetness and peat depth. Variations in vegetational composition also distinguishes some types and subtypes. Pocosin Opening and Low Pocosin communities occur on the deepest peats, have shrub layers a meter or less tall, and have only sparse, stunted trees. High Pocosins occur on shallower peats, have shrub layers up to 2 meters tall, and can support somewhat larger and denser trees. Pond Pine Woodlands occur on even shallower organic deposits and have well-developed tree canopies of *Pinus serotina* and *Gordonia lasianthus*, while Bay Forests have well-developed canopies of *Gordonia, Magnolia virginiana*, and *Persea palustris* without appreciable pine. Peatland Canebrake is distinguished by a largely treeless bed of *Arundinaria tecta* in a peatland setting.

Synonyms: Tall pocosin, short pocosin, evergreen shrub bog, bay forest (a broader concept in common usage, and one which only partially overlaps Peatland Pocosins).

Sites: Peatland Pocosins occur on broad interstream flats in the outer Coastal Plain, in large Carolina bays, and in swales in relict dune fields with low relief – poorly drained settings where

organic matter has accumulated. The most extensive pocosins are domed peatlands believed to be produced by paludification.

Soils: Examples occur on Histosols that range to peats several meters deep. On the less extreme end of the range are soils with organic-rich umbric horizons, such Murville (Umbric Endoaquod). In the shallower organic deposits, plant roots are able to reach the mineral horizons beneath, while in the deeper they are not. All soils are extremely acidic, poor in nutrients, and apparently have nutrients immobilized in organic matter due to inhibited decomposition. Hungerford and Ryan (1988) studied soil structure and found hummocks to be an important part of soil structure and a large pool of soil carbon.

Hydrology: Sites are saturated but do not have standing water other than very locally and receive minimal or no flowing water input from mineral soil areas. The centers of domed peatlands receive water only from rainfall; edges of domed peatlands also receive water by sheet flow from the center. The lower layers of organic matter have low hydraulic conductivity (Daniels et al. 1977), limiting downward movement of water even as water moves frees through less compact upper layers. Water tables may thus be perched, and water is also retained by the high water-holding-capacity of peat. Examples in swales may also be affected by a seasonal high water table. Water in natural sites exits through sheet flow.

Vegetation: Vegetation is characterized by a dense shrub layer consisting of *Lyonia lucida, Ilex glabra, Ilex coriacea, Zenobia pulverulenta, Cyrilla racemiflora, Chamaedaphne calyculata*, *Persea palustris, Magnolia virginiana,* and *Gordonia lasianthus,* rarely *Arundinaria tecta* or *Vaccinium macrocarpon*, along the vine *Smilax laurifolia*, and typically is nearly impenetrable. The shrub layer may be up to 2-3 meters tall or may be a meter or less tall in deeper peats. Tree canopy structure can vary widely with peat depth; the canopy usually is dominated by *Pinus serotina*, alone or with *Gordonia lasianthus*, but may be dominated by *Gordonia* with *Magnolia virginiana* and *Persea palustris*. *Acer rubrum* var. *trilobum* may invade in the long absence of fire, but no other trees are commonly present. Characteristic herbaceous species are *Anchistea virginica*, *Carex striata*, *Andropogon glomeratus, Sarracenia flava, Sarracenia purpurea*, and *Sphagnum* spp. These species may be abundant in Pocosin Opening communities, but otherwise all herbs are sparse. *Andropogon* spp. may be abundant immediately after fire or mechanical disturbance.

Dynamics: Pocosins are naturally influenced by occasional catastrophic fires. Fires are infrequent because the leaf litter is normally saturated and will not burn, and the vegetation normally is not flammable. However, many of the pocosin shrub species are known to be volatile and to burn more readily when wax-covered fresh leaves have emerged in the spring. Nevertheless, the frequent fires burning in adjacent longleaf pine communities generally do not ignite pocosins, and fire will not carry through the vegetation at most times.

In times of drought, plants, leaf litter, and surface peat dry and become flammable. When fires occur, they are intense and uncontrollable, generally killing most or all the above-ground vegetation, often consuming all but the trees and larger stems of shrubs. Peat may ignite locally and smolder for weeks or months. In areas with artificial drainage, peat may burn more extensively and a foot or two of material may be lost. Ignition and sustained burning of peat depend on complex

factors of moisture content, bulk density, and mineral content (Reardon et al. 2007). Hummocks may be an important factor in igniting peat since they are drier and less compact.

Pocosin vegetation is well adapted to recovering from catastrophic fire. *Pinus serotina* is able to survive severe fires that kill its branches, through epicormic sprouting. It has serotinous cones that store seeds on the tree for several years and release them when heated; it thus can establish seedlings on newly burned surfaces. All of the characteristic shrubs, hardwoods, vines, and herbs sprout vigorously after being top killed. Christensen et al. (1981) reported that a burned pocosin regained 20% of its prefire biomass in the first growing season. They reported that some species, such as *Zenobia* and various herbs, recover particularly quickly and dominate for several years after a fire, until they are out-competed by *Lyonia.* Species diversity is generally highest right after a fire and declines gradually. Pocosin vegetation can be observed to be back to its characteristic height and density just a few years after a fire. As time since fire increases, an increasing load of dead twigs and vines can be found on the standing shrubs. This presumably increases the flammability of the vegetation.

Where fire burns into the peat deeply enough to kill the roots of shrubs, a long-lasting wet basin may form. Deep peat burn patches are believed to be the origin of the patches of Pocosin Opening communities. These depressions are presumed to slowly fill with organic matter until they can support Low Pocosin shrubland vegetation. These particular communities may therefore form a shifting mosaic over time. However, in observing a number of pocosins that have had intense fires, I have not seen an increase in Pocosin Openings and their associated plants after fire.

As is characteristic of bogs, pocosins are limited not just by wetness but by extremely low availability of plant nutrients. Nutrients are not released by decomposition both because of the saturated soil and because of the high carbon and low nutrient content of most of the litter. Phosphorous has been found to be the limiting nutrient (Wilbur and Christensen 1983). The rapid growth following fire presumably is because of the sudden release of phosphorous and other nutrients in the ash. In pocosins that contain it, *Zenobia pulverulenta* often grows particularly quickly after a fire and dominates the vegetation for a time. In a few years, the taller but slower growing shrub such as *Lyonia lucida* overtop it. Simms (1987) demonstrated experimentally that *Zenobia pulverulenta* is better able to respond to addition of nutrients with increased growth.

Otte (1981) described the longer-term dynamics of the large pocosin complexes, inferred from peat sampling. Most peatlands originated in blocked drainage systems, which are indicated by channel-like bands of deeper peat. Through paludification, the organic layer thickened and spread out from the channel across the flat uplands; some even spread across drainage divides. Peat accumulation, and presumably the blockage, began 10,000-12,000 years ago. Sea level was about 25 meters lower then, and the coast was distant enough that coastal processes probably were not involved. The cause of blockage is unknown, but channels appear to end at areas of sandy sediment, so sand movement may have been involved. Most peat deposits started as herbaceous marsh, and changed to cypress or white cedar swamp, leaving numerous logs in the peat. Shrubby pocosin vegetation developed relatively late in the accumulation of most peatlands, though still presumably millennia ago and apparently driven by natural causes. Otte also indicated that peatland pocosins were still expanding, peat deepening, and thus central pocosin vegetation getting

lower at present, or at least they were until artificial drainage and soil disruption at the edges put an end to the process.

Otte (1981) also mentioned the idea of secondary pocosins, pocosin shrub vegetation that has developed in historical times after swamp forest was logged and was unable to regenerate. This may be possible because the loss of evapotranspiration would increase the wetness after logging. However, he also noted that peatland swamp forests occurred on peats with higher mineral content, especially clay, and in places where some overland flow brought nutrients into the site, rather than being indistinguishable from pocosin sites. Historical records sometimes suggested to support the idea of recently developed, anthropogenic pocosins, but do not seem to be specific enough about locations. As an example, a large volume of timber was removed from the Green Swamp, a place where conservation lands are now dominated by pocosin vegetation. However, the area known as the Green Swamp was much larger and most of it had different soils. It is likely that swamp forests on other soils were logged and converted, while pocosin that existed at the time of logging was ignored because it lacked merchantable timber. Indeed, the pocosin remains because it was not suitable for conversion to pine plantation along with the rest of the swamp.

Frost (2000) suggested it was likely there was short vegetation resembling Low Pocosin on shallower peats, kept low by frequent fire. Given the greater frequency of the fire in the past, this is possible. Wells (1946) also thought that a fire interval of 4-6 years would keep shrubs low, while not allowing *Zenobia* to become dominant. However, no existing Peatland Pocosin vegetation appears to behave in this way at present. Pocosin vegetation seems to need time to become flammable after fires, and all but the canebrakes seem to be incapable of burning frequently.

There is a more general concept of a potential long-term shifting mosaic of communities of shallow organic soils. Pond Pine Woodland, Bay Forest, Peatland Atlantic White Cedar Forest, Nonriverine Swamp Forest, Peatland Canebrake, even High Pocosin and Low Pocosin, are suggested to be results of different disturbance histories, with an implication that their sites could readily become any of the other communities. Various sources describe bay forests as an end stage of succession for Peatland Atlantic White Cedar Forest, Pond Pine Woodland, or shrubby pocosins with the long absence of fire (Buell and Cain 1943; Kologiski 1977). Christensen (1988) suggests that shallow peat burns may allow either *Chamaecyparis* or *Pinus serotina* establishment. This appears reasonable, but evidence is hard to find. These two species generally do not coexist in a range of proportions, and the author has not observed any examples of conversion in burned areas. Landscape patterns of existing occurrences do not resemble patch mosaics but look more like zonation based on site characteristics. Those site factors may include chronic disturbance regimes, influenced by natural fire breaks or connections to more flammable vegetation, but are less likely to change over time. However, disturbance history has more potential to influence communities in transitional areas, potentially shifting boundaries from one time to another.

Comments: The primary terminology and concepts of types used here follow Otte (1981) and are little changed from those published in Weakley and Schafale (1991). A competing terminology of "tall pocosin" and "short pocosin," not used, is based on the same gradient of peat depth and vegetation stature. Otte (1981) made extensive observations of vegetation as well as site conditions while sampling peat in pocosins. Despite its never being formally published, this work has been widely cited. Except where noted, I have corroborated most of his observations of the patterns of

Low Pocosin, High Pocosin, and Pond Pine Woodland. Though using other terminology, Snyder (1980), Wells (1946), and Dachnowski-Stokes and Wells (1929) noted similar patterns. Pocosins are often called evergreen shrub bogs in literature, but as Christensen et al. (1981) noted, some are dominated by deciduous species.

Descriptions of pocosins in literature are often confusing, partly because of different uses of terminology and partly because of confusion of boundaries by alterations such as logging and fire exclusion. The term "bay forest" has been used in a variety of ways, many of which are much broader than used here. The difficulty of penetrating pocosin sometimes leads to samples being taken in uncharacteristic areas on the edges. Many of the CVS plots, for example, contain species not characteristic of well-developed pocosins. Christensen et al. (1981), for example, mention *Pinus palustris* as potentially present in pocosins, but this species would be present only in overgrown mineral soil edges that have come to deceptively resemble pocosins.

The linking of canebrakes to pocosins is somewhat uncertain. Westward, canebrakes are associated with large river bottoms and are dominated by *Arundinaria gigantea* rather than *Arundinaria tecta*. In the Coastal Plain of North Carolina, however, despite the presence of *Arundinaria* along rivers, canebrakes appear to have been associated with streamheads and with extensive organic wetlands. Most of the few remnants are associated with pocosins. However, the best documented historical canebrake, The Green Sea, appears associated with Coastal Plain Nonalluvial Wetlands and other examples may also have been. Bay Forest too is sometimes associated with Nonalluvial Wetlands rather than with other Peatland Pocosin communities.

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KEY TO PEATLAND POCOSINS

1. Vegetation with substantial tree cover, more than 25% cover when not recently burned and under normal conditions; trees not greatly stunted; occurring on shallow organic layers or on peats with higher mineral content
   2. Canopy dominated by evergreen hardwoods: *Gordonia lasianthus, Magnolia virginiana*, and *Persea palustris*. *Pinus serotina*, if present, not codominant. ..... **Bay Forest**
   2. Canopy dominated by *Pinus serotina*, sometimes with *Gordonia lasianthus* codominant and equal in abundance. *Magnolia* and *Persea* present in smaller amounts and generally not in the canopy.
      3. Shrub layer dominated by *Arundinaria tecta*. Broadleaf shrubs a small minority, but may increase with time since fire. ..... **Pond Pine Woodland (Canebrake Subtype)**
      3. Shrub layer dominated by broadleaf evergreen shrubs.
         4. Located north of Albemarle Sound; shrub layer always lacking *Cyrilla racemiflora*; .... **Pond Pine Woodland (Northern Subtype)**
         4. Located south of Albemarle Sound; shrub layer usually with *Cyrilla racemiflora* .... **Pond Pine Woodland (Typic Subtype)**

1. Vegetation without substantial tree cover, persistently less than 25% cover even when not recently burned; what trees are present substantially stunted, usually of much smaller size than the same species reach in other communities; occurring on deeper organic layers with low mineral content (or shallow peat in Peatland Canebrake).
   5. Shrub layer dominated by *Arundinaria tecta*; broadleaf shrubs a minority, but may increase with time since fire. ..... **Peatland Canebrake**
   5. *Arundinaria tecta* not dominant; generally absent, but may be present as a minority component.
      6. Shrub layer persistently shorter than 1.5 meters tall, peat generally deeper than 1.5 meters and very low in mineral content.
         7. Shrub layer dominated by upright shrubs, generally *Zenobia pulverulenta, Cyrilla racemiflora, Lyonia lucida*, or *Ilex glabra*.
            8. Shrub layer with a large component of *Cyrilla racemiflora*, in addition to *Zenobia, Lyonia lucida*, and *Ilex glabra*; located in the outer Coastal Plain south of the Neuse River .... **Low Pocosin (Titi Subtype)**
            8. Shrub layer lacking *Cyrilla racemiflora*, dominated by *Zenobia, Lyonia*, or *Ilex*; located in the middle or inner Coastal Plain or in the outer Coastal Plain north of the Neuse River. .... **Low Pocosin (Gallberry—Fetterbush Subtype)**
         7. Shrub layer dominated by trailing shrubs: *Chamaedaphne calyculata* or *Vaccinium macrocarpon*; upright shrubs present in smaller amounts.
            9. Community containing significant amounts of *Vaccinium macrocarpon*, though not necessarily dominant. ..... **Pocosin Opening (Cranberry Subtype)**
            9. Community lacking *Vaccinium macrocarpon*.
               10. Community containing significant amounts of *Sarracenia* spp., though *Anchistea virginica, Carex striata*, and other herbs may have more cover .... **Pocosin Opening (Pitcher Plant Subtype)**
               10. Community lacking *Sarracenia* spp., or having less than 1% cover of them; *Anchistea virginica*, *Carex striata*, and other herbs dominate. ..... **Pocosin Opening (Sedge-Fern Subtype)**
      6. Shrub layer generally taller than 1.5 meters, unless recently burned; trees stunted but larger and more abundant; peats generally less than 1.5 meters deep, or with higher mineral content.
         11. Shrub layer dominated by evergreen shrubs, generally *Lyonia lucida, Cyrilla racemiflora, Ilex glabra*, or *Ilex coriacea*. ..... **High Pocosin (Evergreen Subtype)**

11. Shrub layer dominated by deciduous shrubs, generally *Zenobia pulverulenta, Vaccinium* spp., or *Ilex laevigata*. ..... **High Pocosin (Deciduous Subtype)**

LOW POCOSIN (GALLBERRY–FETTERBUSH SUBTYPE)

Concept: Low Pocosins are communities of the deepest peats, with a prevailing shrub height of less than 1.5 meters tall in the absence of fire, due to low fertility and wetness. Most occur in the centers of domed peatlands, but they may also occur in Carolina bays or smaller peat basins. The Gallberry–Fetterbush Subtype covers the more northern and more inland examples, in which *Cyrilla racemiflora* is absent or only a minor component. *Lyonia lucida*, *Ilex glabra*, and *Zenobia pulverulenta* generally dominate.

Distinguishing Features: Low Pocosins are distinguished from other pocosin communities by a shrub layer persistently less than 1.5 meters tall, consisting of upright broadleaf shrubs. Most Low Pocosins do contain patches of taller shrubs and scattered, stunted *Pinus serotina*, but these are a minor component. Peatland Canebrakes have *Arundinaria tecta* shrub layers rather than broadleaf shrubs, while Pocosin Opening communities have trailing shrubs (*Chamaedaphne calyculata*) and herbs dominating. High Pocosin and Pond Pine Woodland may have shrubs less than 1.5 meters tall for a few years after a fire, but evidence of prevalence of taller shrubs before the fire, along with larger pines, distinguish them. The transition to High Pocosin sometimes occurs as an increase in abundance of tall shrub patches so that the average vegetation height increases, but more often occurs with a gradual increase in prevailing shrub height.

The Gallberry–Fetterbush Subtype is distinguished from the Titi Subtype by the absence of *Cyrilla racemiflora* and corresponding geographic location. *Cyrilla racemiflora* may be present in nearby Pond Pine Woodland communities or even in scattered tall shrub patches, but is scarce or absent within the Low Pocosin itself.

Synonyms: *Ilex glabra - Lyonia lucida - Zenobia pulverulenta* Shrubland (CEGL003944).
Ecological Systems: Atlantic Coastal Plain Peatland Pocosin and Canebrake (CES203.267).
Short pocosin.

Sites: Low Pocosins generally occur in the central, deepest parts of domed peatlands on poorly drained interstream flats, but also occur in peat-filled Carolina bays and deep peat-filled swales. Peat deposits tend to be greater than 1 meter deep, sometimes 3-4 meters deep. The Gallberry–Fetterbush Subtype occurs in more northern and more inland locations.

Soils: Soils are Histosols, most typically Dare (Typic Haplosaprist), sometimes Croatan or Pamlico (Terric Haplosaprist).

Hydrology: Sites are saturated all year in all but drought periods. Most Low Pocosins occupy the centers of domed peatlands, are higher than the surrounding lands, and have no surface or ground water draining into them, making them truly ombrotrophic. A number of examples occur in the interior of Carolina bays. It is less clear if these are ombrotrophic, but it is likely that they are. The peat generally is deep and saturated enough that plant roots never reach mineral soil (Otte 1981). However, during droughts, the peat may dry out enough to burn.

Vegetation: Low Pocosin vegetation is a short shrubland, with the prevailing shrub height less than 1.5 meters tall even in the absence of recent fire. The shrub layer is dominated by

combinations of *Lyonia lucida, Ilex glabra,* or *Zenobia pulverulenta*. *Smilax laurifolia* is often prominent, draping over the shrubs. In shorter or less dense areas, *Chamaedaphne calyculata* is often abundant, and *Vaccinium crassifolium*, occasionally *Vaccinium macrocarpon,* may occur. Other shrubs that may be abundant in some examples, but are less constant, include *Persea palustris, Ilex coriacea*, *Kalmia carolina*, *Kalmia cuneata*, *Aronia arbutifolia*, *Vaccinium fuscatum, Vaccinium formosum*, and *Morella caroliniana*. *Pinus serotina* is present as very stunted, scattered individuals. *Persea palustris*, *Magnolia virginiana*, and occasionally *Gordonia lasianthus* are similarly present as small trees or shrubs. The trees often occur in scattered patches a few meters across, where shrubs are also taller. *Sphagnum* spp. may be fairly abundant. Most herbs are in associated Pocosin Opening patches, but *Carex striata* and *Anchistea virginica* may be abundant in places. *Sarracenia flava*, *Sarracenia purpurea*, and other herbs of Pocosin Openings may be present in small numbers. *Andropogon glomeratus* is often abundant shortly after fires.

Low Pocosins often contain small patches of taller vegetation dotted through the area. These typically are dominated by the taller dominant shrub species and are more likely to contain *Pinus serotina*.

Range and Abundance: Ranked G2. Low Pocosins represent the extreme of peatland development. There are many fewer occurrences than High Pocosins or Pond Pine Woodlands. However, where they occur, they often are very extensive, some occupying multiple square miles.

In North Carolina, the Gallberry–Fetterbush Subtype occurs in more inland Carolina bays, such as those of Bladen and Cumberland counties, and in more northerly peatlands. It makes up most or all of the Low Pocosins north of the Neuse River. The equivalent association is reported to be in South Carolina, in Francis Marion National Forest. This pattern deserves further investigation, given its contrast with the more northern and inland distribution in North Carolina. Most examples and an even larger fraction of the acreage of this community occurs in North Carolina.

Associations and Patterns: Low Pocosins are large patch communities. They may occupy large areas but do not form a typical repeated part of the landscape. However, they might be regarded as matrix communities in deep peatlands, where patches are very large. They often occur in a fine-scale mosaic with Pocosin Opening communities. Low Pocosins and Pocosin Openings occur in the central parts of peatlands, those areas that are raised above their surroundings or most isolated from bay rims, and thus are most completely ombrotrophic. They grade to High Pocosin toward the edge, where peats are shallower.

Variation: No variants are named. Stature of vegetation increases with decreasing peat depth. Dominance, stature, and diversity also vary with time since fire. A distinctive version of vegetation in Bushy Lake may warrant recognition as a variant, or even a subtype, but needs more investigation.

Dynamics: Low Pocosins are the most nutrient-poor pocosin communities. The low stature of the vegetation results from extreme nutrient limitation as well as wetness. Because they are on the highest parts of domed peatlands, they may not be wettest sites. Most of the species will grow

taller in other communities, and Low Pocosin communities that are drained or fertilized lose their characteristic short vegetation.

Most Low Pocosins contain interspersed patches of taller vegetation a few meters across, where most of the trees occur and where shrubs are also taller. They often appear striking on aerial photos, where they appear to be regularly distributed. The origin and dynamics of these patches are not well known. They have less compact peat because of the structure provided by the tree roots, and they appear to be slightly raised. They thus represent slightly more favorable microsites. They may grow in a kind of feedback process, with greater productivity increasing accumulation of organic matter. It has been suggested that, being raised and less compact, they are more prone to ignition of the peat, which presumably would destroy them when it occurred.

Comments: Pocosins are difficult to characterize with vegetation plots. The interior of peatlands, where these communities occur, is particularly difficult to access. Of the relatively few plots that have been sampled, many are in marginal or uncharacteristic areas. Many contain species not found in the interior of Low Pocosins. However, presumably because of their openness, Low Pocosins do sometimes contain unexpected species considered more characteristic of mineral soil, such as *Vaccinium crassifolium* or *Lysimachia asperulifolia*.

The relationship between the Gallberry–Fetterbush Subtype and Titi Subtype needs further investigation. In North Carolina, they seem to have fairly distinct geographic ranges, and it is presumed that something about latitude or climate would be responsible. However, *Cyrilla racemiflora* is present in other communities within the range of this subtype, so the mechanism would need to be something other than a simple range limit. The question is made more complex but the attribution of the association related to this subtype to South Carolina. If it is really the same community, it suggests some other factors are in play.

Rare species:
Vascular plants: *Lysimachia asperulifolia, Peltandra sagittifolia,* and *Rhynchospora alba.*
Nonvascular plants: *Sphagnum fitzgeraldii.*

References:
Otte, L.J. 1981. Origin, development, and maintenance of pocosin wetlands of North Carolina. Rept. to N.C. Natural Heritage Program.

LOW POCOSIN (TITI SUBTYPE)

Concept: Low Pocosins are communities of the deepest peats, with a prevailing shrub height of less than 1.5 meters tall in the absence of fire, due to low fertility and wetness. The Titi Subtype covers more southern examples in which *Cyrilla racemiflora* is a major component along with *Zenobia pulverulenta*, *Lyonia lucida*, and *Ilex glabra*.

Distinguishing Features: Low Pocosins are distinguished from other pocosin communities by a shrub layer persistently less than 1.5 meters tall, consisting of upright broadleaf shrubs. Most Low Pocosins do contain patches of taller shrubs and scattered, stunted *Pinus serotina*, but these are a minor component. Peatland Canebrakes have *Arundinaria tecta* shrub layers rather than broadleaf shrubs, while Pocosin Opening communities have trailing shrubs (*Chamaedaphne calyculata*) and herbs dominating. High Pocosin and Pond Pine Woodland may have shrubs less than 1.5 meters tall for a few years after a fire, but evidence of prevalence of taller shrubs before the fire, along with larger pines, distinguish them. The transition to High Pocosin sometimes occurs as an increase in abundance of tall shrub patches so that the average vegetation height increases, but more often occurs with a gradual increase in prevailing shrub height.

The Gallberry–Fetterbush Subtype is distinguished from the Titi Subtype by the absence of *Cyrilla racemiflora* and corresponding geographic location.

Synonyms: *Cyrilla racemiflora - Zenobia pulverulenta* Shrubland (CEGL003943).
Ecological Systems: Atlantic Coastal Plain Peatland Pocosin and Canebrake (CES203.267).
Short Pocosin.

Sites: Low Pocosins generally occur in the central, deepest parts of domed peatlands on poorly drained interstream flats, but also occur in peat-filled Carolina bays and deep peat-filled swales. Peat deposits tend to be greater than 1 meter deep, sometimes 3-4 meters deep. The Titi Subtype occurs in more southern outer Coastal Plain locations in North Carolina.

Soils: Soils are Histosols, most typically Dare (Typic Haplosaprist), sometimes Croatan or Pamlico (Terric Haplosaprist).

Hydrology: Sites are saturated all year in all but drought periods. Most Low Pocosins occupy the centers of domed peatlands, are higher than the surrounding lands, and have no surface or ground water draining into them, making them ombrotrophic. A number of examples occur in the interior of Carolina bays. It is less clear if these are ombrotrophic, but it is likely that they are. The peat generally is deep and saturated enough that plant roots never reach mineral soil (Otte 1981). However, during droughts, the peat may dry out enough to burn.

Vegetation: Low Pocosin vegetation is a short shrubland, with the prevailing shrub height less than 1.5 meters tall even in the absence of recent fire. The shrub layer is dominated by combinations of *Cyrilla racemiflora, Lyonia lucida, Zenobia pulverulenta,* and *Ilex glabra*. *Smilax laurifolia* is often prominent, draping over the shrubs. In shorter or less dense areas, *Chamaedaphne calyculata* is often abundant, and *Vaccinium crassifolium* may occur. Other shrubs that may be abundant in some examples, but are less constant, include *Persea palustris, Gordonia*

lasianthus, Ilex coriacea, *Kalmia carolina*, *Kalmia cuneata*, *Morella carolinensis,* and *Ilex coriacea*. Most herbs are in associated Pocosin Opening patches, but *Carex striata* and *Anchistea virginica* may be abundant in places. *Sarracenia flava*, *Sarracenia purpurea*, and other herbs of Pocosin Openings may be present in small numbers. *Andropogon glomeratus* is often abundant shortly after fires.

Low Pocosins often contain small patches of taller vegetation dotted through the area. These typically are dominated by the taller dominant shrub species and are more likely to contain *Pinus serotina*.

Range and Abundance: The equivalent association is ranked G2G3, but the community appears equivalent to the G2-ranked Gallberry–Fetterbush Subtype in abundance. Like it, this subtype is present only in the deepest peatlands, but often covers large expanses in the peatland interiors where it is present. In North Carolina, the Titi Subtype occurs in the outer Coastal Plain south of the Neuse River. The association is questionably attributed to South Carolina, but most, if not all, of it is in North Carolina.

Associations and Patterns: Low Pocosins are large patch communities. They may occupy large areas but do not form a typical repeated part of the landscape. However, they might be regarded as matrix communities in deep peatlands, where patches are very large. They often occur in a fine-scale mosaic with Pocosin Opening communities. Low Pocosins and Pocosin Openings occur in the central parts of peatlands, those areas that are raised above their surroundings or most isolated from bay rims, and thus are most completely ombrotrophic. They grade to High Pocosin toward the edge, where peats are shallower.

Variation: No variants are named. Stature of vegetation increases with decreasing peat depth. Dominance, stature, and diversity also vary with time since fire.

Dynamics: Low Pocosins are the most nutrient-poor pocosin communities. The low stature of the vegetation results from extreme nutrient limitation as well as wetness. Because they are on the highest parts of domed peatlands, they may not be wettest sites. Most of the species will grow taller in other communities, and Low Pocosin communities that are drained or fertilized lose their characteristic short vegetation.

As with the Gallberry–Fetterbush Subtype, most examples of this subtype contain interspersed patches of taller vegetation a few meters across, where most of the trees occur and where shrubs are also taller. They often appear striking on aerial photos, where they appear to be regularly distributed. The origin and dynamics of these patches are not well known.

Comments: Pocosins are difficult to characterize with vegetation plots. The interior of peatlands, where these communities occur, is particularly difficult to access. Of the relatively few plots that have been sampled, many are in marginal or uncharacteristic areas. Many contain species not found in the interior of Low Pocosins. However, presumably because of their openness, Low Pocosins do sometimes contain unexpected species considered more characteristic of mineral soil, such as *Vaccinium crassifolium* or *Lysimachia asperulifolia*.

The relationship between the Gallberry–Fetterbush Subtype and Titi Subtype needs further investigation. In North Carolina, they seem to have fairly distinct geographic ranges, and it is presumed that something about latitude or climate would be responsible. However, *Cyrilla racemiflora* is present in other communities within the range of this subtype, so the mechanism would need to be something other than a simple range limit.

Rare species:
Vascular plants: *Lysimachia asperulifolia, Peltandra sagittifolia,* and *Rhynchospora alba.*

References:
Otte, L.J. 1981. Origin, development, and maintenance of pocosin wetlands of North Carolina.Rept. to N.C. Natural Heritage Program.

POCOSIN OPENING (SEDGE-FERN SUBTYPE)

Concept: Pocosin Openings are small patch communities of deep peats, with herbaceous or dwarf shrub dominance, occurring within a Low Pocosin or occasionally High Pocosin matrix. Individual patches are usually small but sometimes abundantly intermixed with Low Pocosin shrub vegetation. The Sedge–Fern Subtype covers the common openings, dominated by the species listed but lacking abundant *Vaccinium macrocarpon* or *Sarracenia* spp.

Distinguishing Features: Pocosin Openings are distinguished from Low Pocosins by the cover of *Chamaedaphne calyculata, Anchistea virginica, Carex striata*, *Sphagnum*, and other smaller plants persistently exceeding that of *Zenobia* and other taller shrubs. The Sedge–Fern Subtype is distinguished by a lack of significant amounts of *Vaccinium macrocarpon* or *Sarracenia* spp.

Synonyms: *Chamaedaphne calyculata / Carex striata var. striata - Woodwardia virginica* Dwarf-shrubland (CEGL004163).
Ecological Systems: Atlantic Coastal Plain Peatland Pocosin and Canebrake (CES203.267).

Sites: Pocosin Openings occur in the central, deepest parts of domed peatlands on poorly drained interstream flats, occasionally in peat-filled Carolina bays and deep peat-filled swales. They occur in local patches that are slightly lower and wetter than the surrounding pocosin. Peat deposits tend to be greater than 1 meter deep, sometimes 3-4 meters deep.

Soils: Soils are Histosols, most typically Dare (Typic Haplosaprist), sometimes Croatan or Pamlico (Terric Haplosaprists). This community may represent small inclusions in these soil series but would still be classified as Typic or Terric Haplosaprists.

Hydrology: Soils are typically saturated all year but may become dry in drought periods. They may hold shallow standing water seasonally. Conditions are at least somewhat wetter than in surrounding Low Pocosin communities. These communities most often occur in the centers of large peat domes, where they receive only rain water input and are truly ombrotrophic. Examples in Carolina bays likely also are ombrotrophic.

Vegetation: Vegetation in the Sedge–Fern Subtype is dominated by dwarf shrubs and herbs, though stunted upright shrubs, may also be a significant component. *Chamaedaphne calyculata* characteristically dominates. Other shrubs, particularly *Zenobia pulverulenta*, but also stunted *Cyrilla racemiflora, Lyonia lucida*, *Ilex glabra*, or *Persea palustris* are common. Most other shrubs of Low Pocosin may be present. *Smilax laurifolia* often forms a layer on top of the shrubs. *Sphagnum* spp., *Anchistea virginica*, and *Carex striata* are the dominant herbs. *Andropogon glomeratus* may be abundant, especially soon after fires. Other herbs present in small numbers or with low constancy may include *Sarracenia flava, Sarracenia purpurea* var. *venosa, Drosera intermedia*, *Rhynchospora chalarocephala, Rhynchospora fascicularis, Xyris fimbriata*, *Utricularia subulata*, other *Utricularia* species, *Peltandra sagittifolia*, and in a couple of sites, *Lysimachia asperulifolia*.

Range and Abundance: Ranked G1G2. This community apparently is endemic to North Carolina. The full abundance and range are not well known, though this clearly is the most abundant subtype. It is not clear that it is present in well-developed form in all large peatlands, although it may be.

Associations and Patterns: Pocosin Openings occur as series of small patches embedded in Low Pocosins, occasionally with a few patches also in High Pocosins. The Sedge–Fern Subtype may be the only subtype present, but it generally is also present where either of the other two subtypes occur. It may occur with either subtype of Low Pocosin.

Variation: Examples vary in wetness and amounts of the component species. No variants are recognized.

Dynamics: The relationship of Low Pocosin and Pocosin Openings needs further investigation. Pocosin Openings are believed by many to result from peat burns that kill established shrubs and create shallow wetter patches. However, peat burn patches generally appear to be bare or to be colonized by weedy species immediately after the fire, and they become difficult to distinguish as time passes. Some plants of Pocosin Openings, such as *Andropogon* and *Rhynchospora*, often appear in newly bare areas, but other characteristic species do not seem to invade newly opened sites so readily. Large, severe fires in many of the large peatlands since 1980 have not obviously resulted in an expansion of Pocosin Opening vegetation.

Pocosin Openings similarly are believed to succeed back to shrubby vegetation, and thus to represent secondary successional patches disturbed by the fire. This too is difficult to observe and has not been definitively documented. It is reasonable to expect, but the rate of succession is unclear. The wetter conditions in the openings, and the lower standing biomass, suggest slower organic matter accumulation than in the surrounding pocosin, which may allow them to persist for many years. Openings may be observed in pocosins that have not burned in decades.

However, there are accounts of more extensive Pocosin Opening vegetation in peatlands in the past. No such large openings appear in more recent aerial photos. This may suggest they are being lost through succession; however, some process other than post-fire succession may be driving their disappearance, or qualitative perceptions of their extent may differ between observations from airplanes, on the ground, and in aerial photos.

Comments: Pocosin Opening communities usually occur in small patches in a matrix of shrubby Low Pocosin communities. The 3rd Approximation considered them part of the heterogeneity of Low Pocosin, as has most earlier literature. They were recognized as distinct associations in the NVC. The decision to recognize them here is uncertain, because patches tend to be very small and are always associated with the same matrix. However, they can aggregate to a significant area, they appear to have different dynamics, they do not occur in every pocosin, and they may be declining. These factors argue in favor of tracking as a separate community entity. The distinctions among different subtypes are also somewhat uncertain.

Rare species:
Vascular plants: *Peltandra sagittifolia*.

References:

POCOSIN OPENING (PITCHER PLANT SUBTYPE)

Concept: Pocosin Openings are small patch communities of deep peats, with herbaceous or dwarf shrub dominance, occurring within a Low Pocosin or occasionally High Pocosin matrix. The Pitcher Plant Subtype covers the uncommon openings in which *Sarracenia* spp. are abundant.

Distinguishing Features: Pocosin Openings are distinguished from Low Pocosins by the cover of *Chamaedaphne calyculata, Anchistea virginica, Carex striata*, *Sphagnum*, and other smaller plants persistently exceeding that of *Zenobia* and other taller shrubs. The Pitcher Plant Subtype is distinguished by *Sarracenia flava* or *Sarracena purpurea* var. *venosa* being abundant. *Sarracenia* generally dominate the aspect of the community, but they may not dominate in absolute cover. *Vaccinium macrocarpon* is absent or scarce.

Synonyms: *Chamaedaphne calyculata / Carex striata var. striata - Sarracenia (flava, purpurea, rubra ssp. rubra)* Dwarf-shrubland (CEGL004164). Ecological Systems: Atlantic Coastal Plain Peatland Pocosin and Canebrake (CES203.267).

Sites: Pocosin Openings occur in the central, deepest parts of domed peatlands on poorly drained interstream flats, occasionally in peat-filled Carolina bays and deep peat-filled swales. They occur in local patches that are slightly lower and wetter than the surrounding pocosin. Peat deposits tend to be greater than 1 meter deep, sometimes 3-4 meters deep.

Soils: Soils are Histosols, most typically Dare (Typic Haplosaprist), sometimes Croatan or Pamlico (Terric Haplosaprists). This community may represent small inclusions in these soil series but would still be classified as Typic or Terric Haplosaprists.

Hydrology: Soils are typically saturated all year but may become dry in drought periods. They may hold shallow standing water seasonally. Conditions are at least somewhat wetter than in surrounding Low Pocosin communities. These communities most often occur in the centers of large peat domes, where they receive only rain water input and are truly ombrotrophic. Examples in Carolina bays likely also are ombrotrophic.

Vegetation: Vegetation in the Pitcher Plant Subtype is dominated by dwarf shrubs and herbs, though upright shrubs may also be a significant component. *Chamaedaphne calyculata* characteristically is the dominant shrub. Other shrubs, particularly *Zenobia pulverulenta* but also stunted *Cyrilla racemiflora, Lyonia lucida*, *Ilex glabra*, or *Persea palustris,* are common. Most other shrubs of Low Pocosin may be present. *Smilax laurifolia* often forms a layer on top of the shrubs. *Sphagnum* spp., *Anchistea virginica*, *Carex striata, Sarracenia flava*, and *Sarracenia purpurea* are the dominant herbs. *Andropogon glomeratus* may be abundant, especially soon after fires. Other herbs present in small numbers or with low constancy may include *Drosera intermedia*, *Rhynchospora chalarocephala, Rhynchospora fascicularis, Xyris fimbriata*, *Utricularia subulata*, other *Utricularia* species, *Peltandra sagittifolia*, or, rarely, *Lysimachia asperulifolia*.

Range and Abundance: Ranked G1G2, but more likely to be G1. This community is endemic to North Carolina. The full abundance and range are not well known, but it clearly is much less extensive and has fewer occurrences than the Sedge–Fern Subtype.

Associations and Patterns: Pocosin Openings occur as series of small patches embedded in Low Pocosins, occasionally with a few patches also in High Pocosins. The Pitcher Plant Subtype usually cooccurs with the Sedge–Fern Subtype and is also present in the one location with the Cranberry Subtype. It may occur with either subtype of Low Pocosin.

Variation: Examples vary in wetness and amounts of the component species. No variants are recognized.

Dynamics: As discussed for the Sedge–Fern Subtype, the dynamic relationship between Low Pocosin and Pocosin Opening communities needs further investigation. The relationship between the Sedge–Fern Subtype and Pitcher Plant Subtype also needs further investigation. Where they cooccur, it is not clear if they are distinguished by different microenvironments, by different successional ages, or by accidents of plant establishment.

There are accounts of more extensive Pocosin Opening vegetation in peatlands in the past, with reports of "acres of pitcher plants" seen from airplanes in remote peatlands in the 1970s. No such large openings appear in more recent aerial photos, and openings of the Pitcher Plant Subtype appear much less numerous than the Sedge–Fern Subtype in current ground level surveys. This may suggest they are being lost through succession. However, large, severe fires in many of the large peatlands since 1980 have not apparently resulted in an expansion of them. Thus, some process other than post-fire succession may be driving their disappearance, or qualitative perceptions of their extent may differ between observations from airplanes, on the ground, and in aerial photos.

Comments: In addition to considerations of whether Pocosin Openings should be considered separate entities from the surrounding Low Pocosins, as discussed for the Sedge–Fern Subtype, there is a question how distinctive the Pitcher Plant Subtype is. It is accepted for the 4th Approximation but would merit further investigation. The abundance of *Sarracenia* spp. is the only known difference between them, and the cause of it is not well known.

Rare species:
Vascular plants: *Lysimachia asperulifolia* and *Peltandra sagittifolia.*

References:

POCOSIN OPENING (CRANBERRY SUBTYPE)

Concept: Pocosin Openings are small patch communities of deep peats, with herbaceous or dwarf shrub dominance, occurring within a Low Pocosin or occasionally High Pocosin matrix. The Cranberry Subtype covers the uncommon openings in which *Vaccinium macrocarpon* is abundant.

Distinguishing Features: Pocosin Openings are distinguished from Low Pocosins by the cover of *Chamaedaphne calyculata, Anchistea virginica, Carex striata*, *Sphagnum*, and other smaller plants persistently exceeding that of *Zenobia* and other taller shrubs. The Cranberry Subtype is distinguished by having appreciable cover of *Vaccinium macrocarpon*. It is known only in Dare County.

Synonyms: *Chamaedaphne calyculata - Vaccinium macrocarpon / Carex striata var. striata - Woodwardia areolata* Dwarf-shrubland (CEGL004165).
Ecological Systems: Atlantic Coastal Plain Peatland Pocosin and Canebrake (CES203.267).

Sites: Pocosin Openings occur in the central, deepest parts of domed peatlands on poorly drained interstream flats, occasionally in peat-filled Carolina bays and deep peat-filled swales. The one well-developed example of this subtype appears to be a Carolina bay that is buried beneath a domed peatland, and therefore has very deep peat. The peat is grounded below present sea level. This community occurs in local patches that are slightly lower and wetter than the surrounding pocosin. Peat deposits tend to be greater than 1 meter deep, sometimes 3-4 meters deep.

Soils: Soils are mapped as Pungo (Typic Haplosaprist). This community may represent small inclusions in these soil series but would still be classified as Typic or Terric Haplosaprists.

Hydrology: Soils are typically saturated all year but may become dry in drought periods. They may hold shallow standing water seasonally. Conditions are at least somewhat wetter than in surrounding Low Pocosin communities. These communities most often occur in the centers of large peat domes, where they receive only rain water input and are truly ombrotrophic.

Vegetation: Vegetation in the Cranberry Subtype is dominated by dwarf shrubs and herbs, though upright shrubs may also be a significant component. *Chamaedaphne calyculata* and *Vaccinium macrocarpon* dominate the woody vegetation. Other shrubs, particularly *Zenobia pulverulenta*, but also stunted *Lyonia lucida*, *Ilex glabra*, or *Persea palustris,* are common. Most other shrubs of Low Pocosin may be present. *Smilax laurifolia* often forms a layer on top of the shrubs. *Sphagnum* spp. is extensive in the ground cover. *Anchistea virginica* and *Carex striata* are the dominant herbs. *Andropogon glomeratus* may be abundant soon after fires. Other herbs include *Rhynchospora alba, Rhynchospora fascicularis* var. *fascicularis, Sarracenia flava*, *Sarracenia purpurea, Drosera intermedia, Xyris ambigua*, *Calopogon barbatus, Peltandra virginica, Rhynchospora plumose*, and *Utricularia subulata*.

Range and Abundance: Ranked G1. This community is endemic to North Carolina and is known only from a single, albeit extensive, occurrence in Dare County.
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Associations and Patterns: Pocosin Openings occur as series of small patches embedded in Low Pocosins, occasionally with a few patches also in High Pocosins. It is associated with the Sedge-Fern Subtype and potentially with the Pitcher Plant Subtype. The only example is associated with the Gallberry Fetterbush Subtype of Low Pocosin.

Variation: Examples vary in wetness and amounts of the component species. No variants are recognized.

Dynamics: As discussed for the Sedge-Fern Subtype, the dynamic relationship between Low Pocosin and Pocosin Opening communities needs further investigation. The relationships among the subtypes also need further investigation. Where they cooccur, it is not clear if they are distinguished by different microenvironments, by different successional ages, or by accidents of plant establishment. The occurrence of *Vaccinium macrocarpon* presumably is relict. The species is present at several other sites in Dare County and nearby counties.

Comments: This subtype appears to be associated with a distinctive biogeographic history. The Dare County Pocosin where it occurs appears to have been an open pocosin much longer than most peatlands in the state. It also appears to be wetter and more extensive than Pocosin Openings in other peatlands. However, it is less clear that it is wetter than patches of other subtypes in the same pocosin.

Rare species:
Vascular plants: *Rhynchospora alba* and *Vaccinium macrocarpon*.

References:

HIGH POCOSIN (EVERGREEN SUBTYPE)

Concept: High Pocosins are shrub bog communities of intermediate-depth peats, with a prevailing shrub height greater than 1.5 meters but with a sparse, poorly-developed tree canopy. The Evergreen Subtype covers the typical examples dominated strongly by evergreen shrubs, generally *Lyonia lucida*, *Ilex glabra*, and *Cyrilla racemiflora*.

Distinguishing Features: High Pocosins are distinguished from other peatland pocosins by having dense shrub layers persistently greater than 1.5 meters tall (except immediately after fire) but lacking a well-developed tree canopy (cover less than 25 percent and trees stunted). Pond Pine Woodlands that have recently burned may have similar tree stature and cover, but generally will show evidence of having supported larger and denser trees before the fire. However, Pond Pine Woodland that has been logged may be difficult to distinguish, and other forests with evergreen shrubs may also come to deceptively resemble High Pocosin if clearcut.

High Pocosins are distinguished from Streamhead Pocosins by not occurring in seepage-fed drainages in sandhill terrain. They lack *Liriodendron tulipifera, Toxicodendron vernix*, and other characteristic streamhead species and often have *Gordonia lasianthus* as a component. They are distinguished from Small Depression Shrub Border by occurring on peats, not being associated with small depressions, and lacking other characteristic species such as *Ilex myrtifolia* and *Nyssa biflora*.

The Evergreen Subtype is distinguished from the Deciduous Subtype by having only a minor amount of deciduous shrubs such as *Zenobia pulverulenta* and *Vaccinium* spp. It is distinguished from Peatland Canebrake by having broadleaf shrubs dominant, though *Arundinaria tecta* may be present in small amounts.

Synonyms: *Pinus serotina / Lyonia lucida - Ilex glabra - (Cyrilla racemiflora)* Shrubland (CEGL003846).
Ecological Systems: Atlantic Coastal Plain Peatland Pocosin and Canebrake (CES203.267).
Pine-Ericalean Pocosin (Kologiski 1977) (in part). Included in the Short Pocosin category of Snyder (1980). Shrub bog (general usage).

Sites: High Pocosins occur on peats that are typically about 1.5 meters deep, in the intermediate parts of the deeper domed peatlands, in centers of shallower peatlands, or in peat-filled Carolina bays and swales. Peat deposits may be deeper or shallower in other conditions that give similar nutrient levels.

Soils: Soils are usually Terric Haplosaprists, most often mapped as Pamlico or Croatan. A few are mapped as Dare (Typic Haplosaprist) and a few are mapped as deeper or shallower peats. Soil mapping often does not distinguish different soils for High Pocosin and Low Pocosin.

Hydrology: Soils are saturated at the surface seasonally or all year. High Pocosins occurring in domed peatlands are slightly higher than the surrounding lands and the only surface or ground water that drains into them comes from other pocosins, making them largely ombrotrophic. High pocosins in Carolina bays and swales occupy low areas that lack mineral input, or occur in the

interior of peat-filled depressions where any nutrients in incoming water are filtered out by peat on the periphery. The peat is deep and saturated enough that plant roots can reach mineral soil only during droughts (Otte 1981). Small, permanently flooded depressions may occur, but are less common than in Low Pocosin.

Vegetation: High Pocosin vegetation is a dense tall shrubland with stunted trees widespread but with less than 25% overall cover even with no recent fire. The shrub layer is 1.5 to 3 meters tall, except when recovering from fire. The open canopy consists almost exclusively of *Pinus serotina*, though *Gordonia lasianthus*, *Magnolia virginiana*, or *Persea palustris* may occur in small numbers. The shrub layer is dominated by *Lyonia lucida*, *Cyrilla racemiflora*, *Ilex glabra, Ilex coriacea*, and the hardwoods listed above. *Smilax laurifolia* is frequent and often forms large tangles. *Arundinaria tecta* may be present but does not dominate. Other shrub species, such as *Zenobia pulverulenta, Aronia arbutifolia*, *Vaccinium fuscatum*, or *Vaccinium formosum*, may occur in small numbers. Herbs are sparse. *Anchistea virginica* is most frequent. In small openings created by peat consumption in fires or sometimes by mechanical disturbance, a few other herbs may be common: *Carex striata*, *Andropogon glomeratus*, and the rare *Peltandra sagittifolia*. *Sphagnum* spp. may occur in small amounts.

Range and Abundance: Ranked G3. Most High Pocosins are the Evergreen Subtype. They range throughout the outer terraces of the Coastal Plain, where they are present in all larger peatlands and many of the peat-filled Carolina bays. The equivalent association ranges southward to Florida, but North Carolina appears to have most of the occurrences.

Associations and Patterns: High Pocosins occur as large patch communities. They may dominate the center of a large peatland or Carolina bay, or they may be a broad to narrow intermediate zone outside of a Low Pocosin center. They almost always grade to Pond Pine Woodland on the outer edges with shallower organic deposits. Other Peatland Pocosin communities, such as Bay Forest or Peatland Canebrake, may also occur in the mosaic. The Deciduous Subtype usually is in different Carolina bays than the Evergreen Subtype, but they can co-occur.

Variation: Stature of vegetation increases with decreasing peat depth. Dominance, stature, and diversity also vary due to fire cycles. Theoretically, differences in hydrology, fire regime, and other site factors between large peatlands and Carolina bays might create differences in pocosins in these settings, but such differences have not been documented.

Dynamics: High Pocosins are intermediate in nutrient levels and productivity, between Low Pocosins and Pond Pine Woodlands. Nutrient shortages limit the size and density of trees, which remain small and generally low in density even with the long absence of fire. There is some question about the range of density. An extensive High Pocosin in Holly Shelter Swamp, which had a sparse pine canopy, regenerated with a much denser pine canopy after a severe wildfire. This needs further investigation. Recovery from fire may be somewhat slower than in Low Pocosin because of the higher normal biomass, but productivity is also higher. Some species, such as *Zenobia* and various herbs, recover particularly quickly and dominate several years after a fire, until they are out-competed by *Cyrilla* and *Lyonia* (Christensen et al. 1981; Wilbur and Christensen 1983). Species diversity is generally highest right after a fire and declines gradually. Some species, such as *Peltandra sagittifolia*, appear to be exclusively associated with severely disturbed patches.

Tree regeneration is driven by fires, which create bare ground and release seeds from serotinous cones. Tree density and stature in the long term presumably are driven by nutrient limitation. However, a fire can significantly change the tree density in either direction in a High Pocosin or Pond Pine Woodland, and this may lead to apparent changes in the boundary between the two in transitional areas.

The natural dynamic relationship of High Pocosin and Peatland Canebrake is not well known. It is reasonable, as suggested by Frost (2000), that canebrakes might be invaded by shrubs and come to resemble High Pocosin in the long absence of fire, though others are known to have been invaded by hardwood trees. Any High Pocosin that contains *Arundinaria* may have the potential to become dominated by it with frequent burning, and *Arundinaria* will support burning more frequently than broadleaf shrubs will. However, it is unclear if these communities interchanged on a regular basis, or if they occurred as a stable mosaic in areas that promoted different fire frequency. Both shrubs and cane appear capable of promoting the fire regime that benefits them, so feedback between vegetation and fire may have stabilized both communities.

Comments: Much of the literature on pocosin ecosystems is general and does not distinguish High Pocosins specifically. Their location relative to the terminology of tall and short pocosin is also sometimes unclear.

Similar vegetation occurs in southern Virginia on small peat bodies along tidal rivers. No similar vegetation is known in North Carolina in such a setting.

Rare species: *Kalmia cuneata, Lysimachia asperulifolia,* and *Peltandra sagittifolia*.

References:

Christensen, N.L., R. Burchell, A. Liggett, and E. Simms. 1981. The structure and development of pocosin vegetation. In C.J. Richardson (ed.): Pocosin wetlands: an integrated analysis of Coastal Plain freshwater bogs in North Carolina. Hutchinson Ross Publ. Co.

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HIGH POCOSIN (DECIDUOUS SUBTYPE)

Concept: High Pocosins are shrub bog communities of intermediate-depth peats, with a prevailing shrub height greater than 1.5 meters but with a sparse, poorly-developed tree canopy. The Deciduous Subtype covers uncommon, poorly known examples with a significant deciduous shrub component, usually *Zenobia pulverulenta* but sometimes *Vaccinium* spp. or other species.

Distinguishing Features: High Pocosins are distinguished from other peatland pocosins by having dense shrub layers persistently greater than 1.5 meters tall (except immediately after fire) but lacking a well-developed tree canopy (cover less than 25 percent and trees stunted). Pond Pine Woodlands that have recently burned may have similar tree stature and cover, but generally will show evidence of having supported larger and denser trees before the fire. However, Pond Pine Woodland that has been logged may be difficult to distinguish, and other forests with evergreen shrubs may also come to deceptively resemble High Pocosin if clearcut.

The Deciduous Subtype is distinguished from the Evergreen Subtype by having more than a minor amount of deciduous shrubs such as *Zenobia pulverulenta* and *Vaccinium* spp.

Synonyms: *Pinus serotina / Zenobia pulverulenta - Cyrilla racemiflora - Lyonia lucida* Wooded Shrubland (CEGL004458).
Ecological Systems: Atlantic Coastal Plain Peatland Pocosin and Canebrake (CES203.267).

Sites: The Deciduous Subtype occurs in peat-filled Carolina bays.

Soils: Almost all examples are mapped as Pamlico (Terric Haplosaprist).

Hydrology: Sites are saturated at the surface seasonally or all year. Though occurring in the basins of Carolina bays, these communities presumably do not receive runoff from adjacent mineral soil areas. However, periodic ponding of water may have some influence on their character. Many examples are in bays that were impounded in the past, but it is not clear that all are, and it is not clear what affect this has on vegetation long after ponds were drained.

Vegetation: High Pocosin vegetation is a dense thicket of shrubs, with sparse and small trees. Shrubs are over 1.5 meters tall, but often only reach 2 meters tall, and thus are a bit shorter than in many examples of the Evergreen Subtype. In the Deciduous Subtype, *Zenobia pulverulenta* usually dominates and is often accompanied by *Ilex laevigata, Vaccinium formosum*, *Kalmia carolina*, *Kalmia cuneata*, and *Clethra alnifolia*. Less frequent shrubs listed in site reports include *Lyonia ligustrina*, *Ilex coriacea, Lyonia lucida, Cyrilla racemiflora*, *Vaccinium fuscatum*, *Rhododendron viscosum, Amelanchier obovalis*, and *Gaylussacia frondosa*. *Smilax laurifolia* can be abundant. Several sites have been noted to have *Chamaedaphne calyculata* beneath the tall shrubs. Scattered trees include *Pinus serotina*, but many examples have *Acer rubrum*. It is unclear if this is a natural component, but it is more widespread than in other pocosins. *Persea palustris, Gordonia lasianthus*, and *Magnolia virginiana* are also frequent. Herbs are sparse. A few surveys noted *Carex striata*, *Anchistea virginica*, and *Sphagnum* spp.

Range and Abundance: Ranked G2? In North Carolina, this subtype is known only in the Bladen Lakes areas, with all occurrences confined to Bladen and Cumberland counties. The equivalent association is also attributed to South Carolina.

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Associations and Patterns: The Deciduous Subtype is a large patch community. Examples occur in association with other pocosin communities, especially High Pocosin (Evergreen Subtype) and Pond Pine Woodland (Typic Subtype).

Variation: Variation is not well known. Some different examples have drastically different dominant shrubs, but the meaning of these differences is not apparent.

Dynamics: Dynamics of this subtype are probably similar to other pocosins, but specifics are not well known. In the Evergreen Subtype and High Pocosin, *Zenobia* dominates soon after fires, but is overgrown by evergreen shrubs after a few years. It is unclear why *Zenobia* dominance seems to persist in this subtype. All of the examples were observed long after the last fire.

Comments: The factors that create this subtype are particularly poorly known. Brian van Eerden (personal communication 1994), after visiting numerous Bladen Lakes area pocosins, called them "tall low pocosin," noting that they were intermediate between typical *Zenobia*-dominated Low Pocosin and the typical Evergreen Subtype, and suggested they resembled a fire-suppressed state of Low Pocosin. Besides having *Zenobia* dominance, they often have *Chamaedaphne calyculata*, a species typical of Low Pocosin and Pocosin Opening communities but not of High Pocosin. However, fire-suppressed Low Pocosins in other areas, including other nearby Carolina bays, do not seem to grow tall. The Deciduous Subtype also has other species that are absent or scarce in other pocosins, including *Ilex laevigata, Vaccinium formosum, Vaccinium fuscatum*, and *Clethra alnifolia*. These species are often more abundant in Small Depression Pocosins and other small depression communities, suggesting something in hydrology or fire dynamics may be transitional to the environment of those communities. Other species, such as *Kalmia carolina* and *Kalmia cuneata*, are shared with other High Pocosins in the Bladen Lakes area but seldom elsewhere.

The known existence of past impoundments in some examples suggests a possibility of anthropogenic origin for the Deciduous Subtype. *Acer rubrum* is more often present and abundant in them than in most pocosin communities, which may support this idea. However, not all examples have this history, and a mechanism for that history to create this composition has not been suggested. The composition of known examples appears to be stable. They also have a distinct geographic range. It thus seems likely that they are a distinct natural community.

Rare species:

References:

POND PINE WOODLAND (TYPIC SUBTYPE)

Concept: Pond Pine Woodlands are pocosin communities of shallow peats or mucky mineral soils, with a well-developed, though usually open, canopy of *Pinus serotina*, with or without *Gordonia lasianthus*. The Typic Subtype covers all examples with broadleaf shrub layers, except those at the northern end of the range, where *Cyrilla racemiflora* is absent. This subtype includes the previously recognized subtypes codominated by *Gordonia lasianthus* and those otherwise similar examples that lack it in the canopy.

Distinguishing Features: Pond Pine Woodlands are distinguished from High Pocosins by the presence of a significant tree canopy (greater than 25 percent cover except shortly after fires). They are distinguished from Streamhead Pocosins by occurring on organic deposits in domed peatlands or in shallow basins. Streamhead Pocosins occur in seepage-fed drainages in sandhill terrain and typically contain *Liriodendron tulipifera*, *Toxicodendron vernix*, *Oxydendrum arboreum*, and other species that are absent in Pond Pine Woodlands. Pond Pine Woodlands are most readily distinguished from Small Depression Pocosins by occurring in contiguous patches larger than 5 acres; they also lack appreciable amounts of species more typical of basins, such as *Vaccinium* spp. Pond Pine Woodlands are distinguished from the Pond Pine Subtype of Estuarine Fringe Pine Forest by having a shrub layer dominated by typical pocosin shrubs rather than by *Morella cerifera*. Transitional communities showing a mix of species of these two communities are common and can be expected to develop into typical Estuarine Fringe Pine Forests in just a few years.

Where fire has long been excluded, shrubs and trees from Pond Pine Woodlands can spread into adjacent longleaf pine communities. There they can eventually become as tall and dense as in a typical Pond Pine Woodland. These lost savannas or flatwoods may be difficult to distinguish, but they should not have a well-developed organic layer in the soil. Any presence, even just traces, of species typical of mineral soils, such as *Ctenium aromaticum*, *Aristida stricta*, or *Pinus palustris,* is an indication of this situation, though care must be taken that the species are not on small mineral soil inclusions. Shrub species more characteristic of longleaf pine communities and ecotones may also indicate this, if present in the interior in large numbers. Such species include *Gaylussacia frondosa, Clethra alnifolia*, *Morella cerifera*, *Kalmia carolina*, or *Rhododendron atlanticum*.

The Typic Subtype is distinguished from the Canebrake Subtype by having broadleaf shrubs substantially exceeding *Arundinaria tecta* in cover. Because fire exclusion has led to invasion of canebrakes by shrubs, any substantial presence of *Arundinaria* is likely an indication of the Canebrake Subtype. The Northern Subtype is distinguished from the Typic Subtype by occurring in the northernmost parts of the state and by lacking *Cyrilla racemiflora* as a significant component. However, depauperate examples lacking *Cyrilla* farther south are treated as the Typic Subtype.

Synonyms: *Pinus serotina* - *Gordonia lasianthus / Lyonia lucida* Woodland (CEGL003671).
Pinus serotina / Cyrilla racemiflora - *Lyonia lucida* - *Ilex glabra* Woodland (CEGL003670) is the association lacking *Gordonia*.
Ecological Systems: Atlantic Coastal Plain Peatland Pocosin and Canebrake (CES203.267).

Sites: Pond Pine Woodlands occur near the edges of domed peatlands, in Carolina bays, and in swales in aeolian sand deposits and irregular sandy surfaces such as high stream terraces. They may occur on shallow organic deposits or deeper peats with some input of mineral sediment.

Soils: Shallow Histosols or oligotrophic mineral soils with organic surface layers. The most common series are Murville (Umbric Endoaquod) and Lynn Haven (Typic Alaquod). Other series include Croatan (Terric Haplosaprist), Torhunta (Typic Humaquept), Ponzer (Terric Haplosaprist), Roper (Histic Humaquept), and Pungo (Typic Haplosaprist).

Hydrology: Sites are semipermanently saturated and possibly briefly flooded. The water table is believed to regularly drop to underlying mineral sediment during the dry season, allowing plants to root there (Otte 1981). Water comes from rainwater and sheet flow. Most sheet flow comes from adjacent peatland and brings little nutrient input, but there may be limited influx of slightly less oligotrophic water from adjacent upland areas.

Vegetation: Pond Pine Woodlands exhibit an open to nearly closed canopy of *Pinus serotina*, sometimes codominant with *Gordonia lasianthus*, and with lesser amounts of *Magnolia virginiana* and *Persea palustris*. In more altered examples, *Acer rubrum* var. *trilobum* or *Pinus taeda* may be present. The understory is of the same hardwood species, generally at low density. The shrub layer is tall and very dense, often 4-5 meters tall in examples that are not recently burned. Dominant shrubs are usually *Lyonia lucida*, *Ilex coriacea*, *Ilex glabra*, and *Cyrilla racemiflora*. Other shrubs that may occur in smaller numbers include *Aronia arbutifolia*, *Lyonia ligustrina*, *Vaccinium fuscatum*, *Vaccinium formosum*, *Morella caroliniensis*, *Eubotrys racemosus*, and *Arundinaria tecta*. *Smilax laurifolia* is usually abundant, but few other vines are present. Herbs are generally sparse. *Anchistea virginica* is the only very constant or abundant species, and *Sphagnum* spp. may occur in small amounts.

Where Pond Pine Woodland borders Wet Pine Flatwoods or upland communities, a distinct ecotonal zone often occurs, where the more frequent fire of the uplands interacts with the wetter, organic-surfaced soil of the Pond Pine Woodland. This ecotone, while too small to be classified as a separate community, often contains herbs of Pine Savanna communities, including potentially a number of rare species, such as *Dionaea muscipula* and *Lysimachia asperulifolia*. Where fire is infrequent, the ecotones become shrubby and the distinctive herbs are lost.

Range and Abundance: Ranked G3. The Typic Subtype is widespread in the outer Coastal Plain and in the Bladen Lakes region and is rare to occasional elsewhere in the Coastal Plain. It occurs in South Carolina but does not reach Virginia. North Carolina has a large majority.
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Associations and Patterns: Pond Pine Woodlands can occur as large patches, covering hundreds or even thousands of acres, where they may be associated with pocosin communities on deeper peats. Typically they will grade to High Pocosin toward the interior of the domed peatland or Carolina bay and may be seen as an outer ring zone. However, in other places, such as the Alligator River area, they may be bordered by Nonriverine Swamp Forests through a mosaic of both communities that may reflect fire history. Bay Forests may also occur with them, sometimes centered on incipient drainage systems on the edges of peatlands, but sometimes in mosaics. Pond Pine Woodlands may also occur as large patches without other pocosin communities, or as

stringers or irregular patches of a few acres, in mosaics with Wet Pine Flatwoods or other longleaf pine communities, in relict dune fields or other irregular flat landscapes.

Variation: Two variants are recognized.
1. Loblolly Bay Variant has *Gordonia lasianthus* codominant in the canopy.
2. Shrub Variant has a canopy dominated solely by *Pinus serotina*, though *Gordonia* may be present in the understory.

These variants are recognized as distinct associations in the NVC and were recognized as subtypes in early drafts of the 4th approximation. However, they appear not to be distinctive enough to recognize as subtypes. The presence or complete absence of *Gordonia* does not appear to correlate with any other aspect of the communities.

Otte (1981) divided this range of communities into Pond Pine Woodland and Pond Pine Forest, varying in structure and correlated organic matter depth. The author believes this distinction is not helpful; differences in soil are small, and vegetation stature varies much more in response to disturbance history.

Dynamics: These communities are saturated without appreciable surface flooding, and are nutrient poor, though less so than Low Pocosin or High Pocosin. Otte (1981) emphasized the importance of the water table dropping below the bottom of the organic layer, allowing roots to reach a greater supply of nutrients below. This nutrient supply presumably is a legacy of the geologic past and consists mainly of exchangeable cations such as calcium, as this underlying horizon is also normally anoxic and must have even less nutrient cycling at present.

As with other peatland communities, Pond Pine Woodlands are susceptible to fires during dry periods. Many examples border longleaf pine communities or marshes; they would naturally have been exposed to fire every few years but may not have been flammable enough to burn at all of those times. The natural fire frequency is not well known. The large amount of fuel makes current fires intense in Pond Pine Woodlands. Complete top-kill of all shrubs is common, and the pine canopy often is also killed.

The dominant species sprout readily after fire, and only a few years are apparently required for the dense shrub layer to reach its former height. *Pinus serotina* usually recovers quickly by epicormic and basal sprouts as well as reproduction by seed from serotinous cones. If the pine canopy is killed, recovery of the canopy may take much longer than for the shrub layer. Rare fires may consume soil organic matter and kill the roots of shrubs, leading to a stage of weedy herbaceous cover that may persist some years before the characteristic species reestablish. This has been observed in recent wildfires, especially near artificial drainage, but it is unclear if it would typically occur in more natural conditions. Otte (1981) suggested that fires that reduced the thickness of peat enough to allow more ready access of roots to underlying mineral soil might result in faster growth and taller stature in a recovered community, but I have not observed this.

Frequent fire, probably more often than every 10 years, is more favorable to *Arundinaria tecta* than to broadleaf shrubs and may lead to the development of the Canebrake Subtype, or even to an open Peatland Canebrake community. Conversely, some examples of the Typic Subtype may

have developed from the Canebrake Subtype by exclusion of fire. Frost (1989) suggests that in southeastern Virginia, Pond Pine Woodland-type sites with fire every 3-5 years would support dense, pure canebrake vegetation. With fire every 6-12 years they would alternate between canebrake and shrubby pocosin vegetation, while with less frequent fire *Pinus serotina* would dominate. Which fire regimes prevailed under natural conditions in these sites in North Carolina is uncertain. Because *Arundinaria* is more flammable than the broadleaf shrubs, canebrakes, once established, might maintain themselves by promoting more frequent burning. This could only occur, however, if sources of frequent ignition existed adjacent to the community. If burning were possible at a greater frequency, in patches adjacent to longleaf pine communities, an open pond pine savanna with ground cover of sedges and ferns might occur, but it is unlikely that pond pine would be able to reproduce at this fire frequency.

It has been suggested that, in the absence of fire, Pond Pine Woodlands would succeed to bay forest (Buell and Cain 1943; Monk 1968) (though their concept of bay forest may or may not be the same as the Bay Forest in this document). Abundant canopy *Gordonia* is often interpreted as being a result of long fire suppression. However, large *Gordonia* are quite resilient to fire, and they readily sprout after fire. Atlantic White Cedar Forests too might be established by the occurrence of the right intensity of fire. It may thus be possible that Pond Pine Woodlands can occur in a shifting mosaic with these other communities and also perhaps with Nonriverine Swamp Forest. However, observing a number of wildfires of varying intensity over the last several decades, as well as a number of examples where no fire has occurred in many decades, such a process has not been documented. In the long absence of fire, most examples appear to stagnate or to be invaded by *Acer rubrum*.

See discussion under Vegetation above, about the spread of Pond Pine Woodland-like vegetation into adjacent savannas.

Comments:

Rare species:
Vertebrate animals: *Picoides borealis.*

References:
Buell, M.F. and R.L. Cain. 1943. The successional role of white cedar (*Chamaecyparis thyoides*) in southeastern North Carolina. Ecology 24:85-93.

Frost, C.C. 1989. History and status of remnant pocosin, canebrake, and white cedar wetlands in Virginia. Report to Virginia Natural Heritage Program.

Monk, C.D. 1968. Successional and environmental relationships of the forest vegetation of north central Florida. American Midland Naturalist 79:441-457.

Otte, L.J. 1981. Origin, development, and maintenance of pocosin wetlands of North Carolina. Report to the North Carolina Natural Heritage Program, Raleigh.

POND PINE WOODLAND (NORTHERN SUBTYPE)

Concept: Pond Pine Woodlands are pocosin communities of shallow peats or mucky mineral soils, with a well-developed, though usually open, canopy of *Pinus serotina*. The Northern Subtype covers examples at the northern end of the range of Pond Pine Woodland, north of Albemarle Sound, in which *Cyrilla racemiflora* is absent and *Acer rubrum* and *Clethra alnifolia* become important components.

Distinguishing Features: Pond Pine Woodlands are distinguished from High Pocosins by the presence of a significant tree canopy (greater than 25 percent cover except shortly after fires). See the Typic Subtype description for additional distinguishing features.

The Northern Subtype is distinguished by the combination of northern location with the absence of *Cyrilla racemiflora*. All known examples are north of Albemarle Sound, where the Typic Subtype has not been found. It is unclear if the abundance of *Acer rubrum*, *Clethra alnifolia*, *Gaylussacia frondosa, Morella* spp., and *Eubotrys racemosus* is characteristic of the Northern Subtype in all potential occurrences or if it is a result of alterations or marginal conditions in the few remaining examples that have been sampled or well described.

The Northern Subtype is distinguished from the Canebrake Subtype by having broadleaf shrubs substantially exceeding *Arundinaria tecta* in cover. Because fire exclusion has led to invasion of canebrakes by shrubs, any substantial presence of *Arundinaria* is likely an indication of the Canebrake Subtype.

Synonyms: *Pinus serotina / Ilex glabra / Woodwardia virginica* Woodland (CEGL004652). Ecological Systems: Atlantic Coastal Plain Peatland Pocosin and Canebrake (CES203.267).

Sites: Pond Pine Woodlands occur near the edges of domed peatlands, in Carolina bays, and in swales in aeolian sand deposits and irregular sandy surfaces such as high stream terraces. They may occur on shallow organic deposits or deeper peats with some input of mineral sediment.

Soils: The few remaining examples known occur on deep organic soils: Dorovan, Dare, Pungo, Ponzer, and Belhaven, which are all Terric or Typic Haplosaprists, though presumably less oligotropohic than those that support High Pocosins or Low Pocosins. It is possible examples could occur on shallower organic deposits, as is more common for the Typic Subtype.

Hydrology: Sites are semipermanently saturated and possibly temporarily flooded. Given the prevalence of deep organic soils, it seems unlikely that the water table would drop into the underlying mineral soil, as suggested by Otte (1981) for most Pond Pine Woodlands.

Vegetation: The Northern Subtype has an open to nearly closed canopy of *Pinus serotina*, sometimes codominant with *Acer rubrum* var. *trilobum* or *Magnolia virginiana* in existing examples. An open understory of the same hardwood species, along with *Persea palustris*, may be present. The shrub layer is tall and generally dense, with *Ilex glabra*, *Lyonia lucida*, or *Clethra alnifolia* dominant. Other species noted in examples include *Morella caroliniensis*, *Gaylussacia frondosa*, *Eubotrys racemosus*, *Morella cerifera*, *Lyonia ligustrina* var. *foliosiflora*, and

Vaccinium formosum. *Smilax laurifolia* is often large and dense. Herbs are few, with *Anchistea virginica* most characteristic. *Sphagnum* spp. may be present in small amounts.

Range and Abundance: Ranked G2? This subtype is limited to northeastern North Carolina and adjacent Virginia. All examples are north of Albemarle Sound, where no examples of the Typic Subtype are known. Large peatlands are few in this region.

Associations and Patterns: The few remaining examples occur as large patches on edges of large peatland swamps (Great Dismal Swamp) and in peatlands embedded in wind tidal river valleys. These examples grade to Nonriverine Swamp Forest and Estuarine Fringe Pine Forest (Pond Pine Subtype) respectively. At least one is on the edge of a large, historically documented canebrake — the Green Sea.

Variation: Known examples are too few and too altered to characterize natural variation.

Dynamics: As with other subtypes, this subtype may depend on fire at a low to moderate frequency to maintain it, but it may not. In addition, examples embedded in wind tidal river valleys are often completely surrounded by very wet Tidal Swamps that are not flammable, so the chances of them burning naturally are low. Fire frequency may be less in the geographic range of this subtype than farther south.

Comments: This community was first documented in Virginia, where it is the only kind of Pond Pine Woodland, but it appears to apply to the few North Carolina examples north of Albemarle Sound. Beyond the absence of *Cyrilla* and other southern species, if is unclear how much of its character is natural and how much is a result of more alteration in the area where it occurs. Many of the species that contrast with the Typic Subtype — *Acer rubrum*, *Clethra alnifolia*, *Gaylussacia frondosa, Morella* spp., and *Eubotrys racemosus* — are common further south but occur in less oligotrophic conditions than are typical of Pond Pine Woodlands. If found in Pond Pine Woodland (Typic Subtype), they might indicate unnatural spread of pocosin vegetation into mineral soils with long absence of fire. Fire regimes have been altered longer and more thoroughly in the range of the Northern Subtype than farther south, but fire is also likely to have been somewhat less frequent in this area than farther south. Some species are shared with the anomalous Deciduous Subtype of Low Pocosin, but the reason for the connection is not known.

Some depauperate Pond Pine Woodland vegetation, lacking *Cyrilla racemiflora*, occurs near Lake Worth on the Dare County peninsula, where it is in close proximity to large examples of the Typic Subtype. This could possibly be a disjunct occurrence but may be a result of some kind of alteration.

Rare species:
Vertebrate animals: *Picoides borealis*.

References:
Fleming, G.P., and W.H. Moorhead, III. 1998. Comparative wetlands ecology study of the Great Dismal Swamp, Northwest River, and North Landing River in Virginia. Natural Heritage Technical Report 98-9. Virginia Department of Conservation and Recreation, Division of

Natural Heritage, Richmond. Unpublished report submitted to the U.S. Environmental Protection Agency. 181 pp.

Otte, L.J. 1981. Origin, development, and maintenance of pocosin wetlands of North Carolina. Report to the North Carolina Natural Heritage Program, Raleigh.

POND PINE WOODLAND (CANEBRAKE SUBTYPE)

Concept: Pond Pine Woodland (Canebrake Subtype) communities are *Pinus serotina*-dominated woodlands or savannas with a shrub layer naturally dominated by *Arundinaria tecta*, resulting from more frequent fire than that occurring in other Pond Pine Woodlands.

Distinguishing Features: Pond Pine Woodlands are distinguished from High Pocosins by the presence of a significant tree canopy (greater than 25 percent cover except shortly after fires). See the Typic Subtype description for additional distinguishing features.

The Canebrake Subtype is distinguished from other Pond Pine Woodlands by having a shrub layer dominated by *Arundinaria tecta* rather than by broadleaf shrubs. Given the pervasive alteration of fire regimes, recognition of subtypes can often be only tentative. Some examples that once were the Canebrake Subtype may have had the cane completely eliminated in the absence of fire. Others may exist with a small amount of cane mixed with shrubs. In practice, this subtype should be recognized if *Arundinaria* is abundant and it seems likely that it would dominate with a more natural fire regime. In the absence of abundant *Arundinaria*, this subtype should be recognized only if there is historical information indicating its past dominance at the site.

Synonyms: *Pinus serotina / Arundinaria gigantea ssp. tecta* Woodland (CEGL004433).
Ecological Systems: Atlantic Coastal Plain Peatland Pocosin and Canebrake (CES203.267).

Sites: This subtype occurs in sites similar to other Pond Pine Woodlands, on shallow organic deposits or deeper peats with some input of mineral sediment, on the edges of domed peatlands, and potentially in peat-filled Carolina bays, swales in aeolian sand areas, or other irregular surfaces in the outer Coastal Plain.

Soils: Soils are shallow Histosols or oligotrophic mineral soils with organic surface layers, potentially any of the series listed for the Typic Subtype. It has been suggested in some earlier site descriptions that canebrakes may be more likely to occur on soils with higher mineral content than typical Pond Pine Woodland, but it is unclear if this is true.

Hydrology: Sites are semipermanently saturated and possibly briefly flooded. The water table is believed to regularly drop to underlying mineral sediment during the dry season, allowing plants to root there (Otte 1981). Water comes from rainwater and sheet flow. Most sheet flow comes from adjacent peatland and brings little nutrient input, but there may be limited influx of slightly less oligotrophic water from adjacent upland areas.

Vegetation: The Canebrake Subtype has an open woodland or savanna canopy of *Pinus serotina*, potentially codominant with *Gordonia lasianthus*, and with lesser amounts of *Magnolia virginiana* and *Persea palustris*. There generally is little or no understory. Below is a dense shrub layer with *Arundinaria tecta* dominant or abundant. Frequently burned examples may have little else in the shrub or herb layer. In the present, infrequently burned examples, broadleaf shrubs are present in moderate to large amounts, with *Lyonia lucida*, *Ilex coriacea*, *Ilex glabra*, and *Cyrilla racemiflora* most common. *Smilax laurifolia, Anchistea virginica*, and *Sphagnum* spp. may be present. Other species of the Typic Subtype may be expected to occur. In the one CVS plot taken in this subtype,

Clethra alnifolia was abundant, and *Morella cerifera, Morella caroliniensis*, and *Lorinseria areolata* were also present. *Clethra alnifolia* was abundant in another well-documented example. Given the apparent heavy alteration to all or most remaining examples, the details of natural vegetation are not well known.

Range and Abundance: Ranked G1. Historical references suggest canebrakes once were common, when fire was more common. All remnant examples known are in outer Coastal Plain peatlands, most on the Pamlimarle Peninsula. It is unclear if examples occurred in other regions of the state. The Canebrake Subtype likely once ranged into Virginia.

Associations and Patterns: Natural patterns and associations are poorly known. This subtype probably occurred as a large patch community, similar to most pocosins. Remnant examples are associated with Pond Pine Woodland (Typic Subtype) and with pocosin communities. In more natural landscapes, this subtype may have occurred on edges where peatlands bordered flammable vegetation.

Variation: Too little is known about natural patterns to distinguish variants. The few examples vary in the amounts and species of broadleaf shrubs, but it is unclear if this represents natural variation.

Dynamics: These communities are wet and nutrient poor, though less so than Low Pocosin or High Pocosin. There are suggestions that the Canebrake Subtype may be less nutrient poor than the Typic Subtype.

The natural dynamics of this subtype are not well known, but it is clear that its occurrence depends on fire and that it needs to burn more often than the Typic Subtype or Northern Subtype. *Arundinaria* replaces its biomass much more rapidly than typical shrubs after burning, giving it a competitive advantage over them for a few years after fire. Broadleaf shrubs will grow to predominate and suppress cane after several years, if they are present. Frost (1989) suggests that in southeastern Virginia, Pond Pine Woodland-type sites that burned every 3-5 years would support dense, pure canebrake vegetation. With fire every 6-12 years they would alternate between canebrake and shrubby pocosin vegetation, while with less frequent fire *Pinus serotina* with dense shrubs would dominate.

However, feedback and persistent states can be expected to be important. Persistent frequent fire would eventually eliminate broadleaf shrubs, while persistent infrequent fire would lead to elimination of cane from sites. Neither shrubs nor cane would establish easily in sites dominated by the other, leading to stable states for each subtype over a broader range of fire regimes. Cane, in particular, fruits rarely and primarily reproduces vegetatively. Establishment of new populations where cane is absent must be very rare. Cane is more flammable than shrubs and will burn under a wider range of conditions. Cane, once established, would promote the more frequent fire that it needs, if sources of ignition are present. In practice, the remnant examples of the Canebrake Subtype occur where there has been some recent fire, but far less frequently than suggested by Frost. Most have abundant broadleaf shrubs, but some have shrubs atypical of the Typic Subtype; it is not clear if this is a natural situation or an artifact of fire exclusion.

The relationship of the Canebrake Subtype of Pond Pine Woodland with treeless Peatland Canebrake communities is unclear. Treeless canebrakes could be created from this subtype by frequent and intense enough fire to prevent pond pine regeneration. Given the fire tolerance of established trees, they might persist with infrequent regeneration events when there were breaks in the regularity of fires. However, some historical canebrakes appear to have been on different soils that have not developed Pond Pine Woodlands with exclusion of fire.

It is possible that the Canebrake Subtype existed in a shifting mosaic where it alternated with the Typic or Northern Subtype and with Peatland Canebrake. However, both cane and broadleaf shrubs form dense stands, and both affect fire behavior in ways that would stabilize their dominance once established. It is perhaps more likely that the subtypes occupied different parts of a more stable landscape, responding to differences in prevailing fire frequency created by fire compartment size and by the configuration of more flammable vegetation.

It is also possible that this subtype represents a natural or unnatural transitional state with a relict canopy that is unable to regenerate. However, given the apparent different environment and a plausible mechanism for persistence, it seems best to regard it as a natural community.

Comments: Canebrakes in general apparently were abundant and extensive in early settlement times, but it is unclear how extensive Pond Pine Woodland canebrakes were.

Pinus serotina / Arundinaria gigantea ssp. tecta Wooded Shrubland (CEGL003851) is another similar NVC association, but this distinction between woodland and wooded shrubland does not appear useful, given the rapid changes in structure that can accompany fires or succession following fire.

Bachman's warbler (*Vermivora bachmanii*) has been believed to be associated with cane stands. It is primarily associated with inland cane in bottomland hardwood, and it is unclear if it would have used these communities.

Rare Species:
Invertebrate animals: *Amblyscirtes carolina* and *Amblyscirtes reversa*.

References:
Frost, C.C. 1989. History and status of remnant pocosin, canebrake, and white cedar wetlands in Virginia. Report to Virginia Natural Heritage Program.

Otte, L.J. 1981. Origin, development, and maintenance of pocosin wetlands of North Carolina. Rept. to N.C. Natural Heritage Program.

PEATLAND CANEBRAKE

Concept: Peatland Canebrakes are treeless or sparsely treed vegetation dominated by *Arundinaria tecta* (less than 25 percent tree cover) in peatland and nonriverine wetland settings.

Distinguishing Features: Peatland Canebrakes are distinguished from all other peatland and nonriverine wetland communities by the dominance of *Arundinaria tecta* associated with tree cover less than 25 percent. Examples with more trees are included in the Canebrake Subtype of Pond Pine Woodland. Peatland Canebrakes are distinguished from Streamhead Canebrakes by occurring in flat or basin peatlands or nonriverine wetlands where rainfall and sheetflow, rather than seepage, are the main sources of water.

Synonyms: *Arundinaria gigantea ssp. tecta* Shrubland (CEGL003843). Atlantic Coastal Plain Peatland Pocosin and Canebrake(CES203.267).
Ecological Systems: Southern Atlantic Coastal Plain Nonriverine Swamp and Wet Hardwood Forest(CES203.304). Atlantic Coastal Plain Peatland Pocosin and Canebrake (CES203.267).

Sites: Peatland Canebrakes are believed to occur in sites similar to those supporting Pond Pine Woodlands. Historically documented large examples are on shallow organic deposits or deeper peats with some input of mineral sediment. Canebrakes could potentially occur in peat-filled Carolina bays or swales in aeolian sand areas or other irregular surfaces in the outer Coastal Plain. Historical support for occurrence in these settings is less clear, but smaller patches may not have attracted comment. It is possible that Peatland Canebrakes occurred in a broader range of sites.

Soils: The full range of soils is not well known. It has been suggested in some earlier site descriptions that canebrakes may be more likely to occur on soils with higher mineral content than typical Pond Pine Woodland, but it is unclear if this is true. The few remnants in places where Peatland Canebrakes are historically documented include soils ranging from Terric Haplosaprists (Belhaven and Ponzer) to Histic Humaquepts (Wasda and Roper), to a Typic Endoaqualf (Hydeland).

Hydrology: Sites are seasonally to semipermanently saturated, but the full range of possible hydrology is not known.

Vegetation: Vegetation under natural conditions is believed to be a dense stand of *Arundinaria tecta*, likely 2-3 meters tall. Other details are poorly known. The few remnants tend to have abundant *Acer rubrum* var. *trilobum*, though presumably this species would quickly be eliminated under a natural fire regime. *Pinus serotina* is also abundant in some examples. Broadleaf pocosin shrubs such as *Lyonia lucida, Ilex glabra*, and *Cyrilla racemiflora* may be present, as may less typical pocosin shrubs such as *Clethra alnifolia*.

Range and Abundance: Ranked G1. Only small remnants, highly altered by exclusion of fire, remain. Historic references suggest this community once was common, or at least locally extensive, when fire was more common in peatlands. Hughes (1957), Biswell and Foster (1942), and some earlier writers described vast canebrakes on the wetlands of the Coastal Plain. Byrd (1728) describes one called The Green Sea that took several days to cross. The most plausible

remnant examples known are in outer Coastal Plain peatlands, but at least one possible example is reported on a stream terrace in the Sandhills. West (1934) described cane as abundant in the Embayed Region but did not mention dense canebrakes. However, he reported extant canebrakes in southeastern North Carolina. Both he and Wells (1946) mention *Arundinaria* in Holly Shelter, but it is not clear if it was this community. Peatland Canebrakes once ranged into Virginia, but occurrence in states to the south is less clear.

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Associations and Patterns: Natural patterns and associations are poorly known. Most of the few remnants are associated with pocosins. However, the best documented historical canebrake, The Green Sea, appears associated with Coastal Plain Nonalluvial Wetlands, and other examples may also have been. Peatland Canebrakes at least sometimes occurred as large patch communities, similar to most pocosins. Remnant examples are associated with Pond Pine Woodland (Typic Subtype) and with various other pocosin communities. In more natural landscapes, this subtype may have occurred on edges where peatlands bordered more flammable vegetation.

Variation: Too little is known to recognize natural variation. The strong dominance of cane may have allowed little variation.

Dynamics: See the more extensive discussion under Pond Pine Woodland (Canebrake Subtype). Even more than that community, Peatland Canebrakes presumably depend on frequent fire. Frost (1989, 2000) suggests that Pond Pine Woodland-type sites with fire every 3-5 years would support dense, pure canebrake vegetation. With fire every 6-12 years they would alternate between canebrake and shrubby pocosin vegetation, while with less frequent fire Pinus serotina with dense shrubs would dominate. Peatland Canebrakes are often viewed as likely to have occurred in a shifting mosaic with other peatland communities. However, feedback presumably could help stabilize communities, with canebrakes promoting the frequent fire they need while broadleaf shrubs would reduce fire frequency. In addition, both cane and shrubs, if strongly dominant, would inhibit establishment by the other, allowing them to persist over a broader range of fire frequency.

Comments: This is one of the rarest and most altered natural communities in North Carolina, and therefore one of the hardest to understand. No substantial intact examples remain; the few unconverted remnants in places historically documented to be canebrakes are heavily altered by exclusion of fire and past land uses.

While vegetation called canebrake is believed to have been abundant in early settlement times throughout the Southeast, much was not comparable to these peatland communities of eastern North Carolina. The canebrake literature and descriptions reviewed by Platt and Brantley (1987) largely applies to very different communities of areas west of the Appalachians, where canebrakes are associated with large river bottoms. In the North Carolina Coastal Plain, however, despite the presence of abundant *Arundinaria* along rivers, true canebrakes appear to have been associated with peatlands and streamheads.

Cane was widely regarded as excellent forage, and overgrazing apparently led to its demise in many places (Hughes 1957, Biswell and Foster 1942). Where cane remains abundant, canebrakes potentially could be restored simply by burning frequently.

Rare species: *Amblyscirtes reversa* and *Amblyscirtes carolina.*
Bachman's warber (*Vermivora bachmanii*) has been believed to be associated with cane stands. This species is primarily associated with inland cane in bottomland hardwood, and it is unclear if it would have used these communities.

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BAY FOREST

Concept: Bay Forests are natural peatland forests and woodlands dominated by varying combinations of *Gordonia lasianthus*, *Magnolia virginiana,* and *Persea palustris*.

Distinguishing Features: Bay Forest is distinguished from Pond Pine Woodland, Peatland Atlantic White Cedar Forest, High Pocosin, and other pocosin communities by canopy dominance of *Gordonia lasianthus*, *Magnolia virginiana,* or *Persea palustris* without an appreciable component of *Pinus serotina, Chamaecyparis thyoides,* or other canopy species.

Synonyms: *Gordonia lasianthus – Magnolia virginiana – Persea palustris / Sphagnum* spp. Forest (CEGL007044).
Ecological Systems: Atlantic Coastal Plain Peatland Pocosin and Canebrake (CES203.267).

Sites: Bay Forests occur near the edges of domed peatlands, in peat-filled Carolina bays, and in swales in aeolian sand areas or irregular sandy surfaces such as high stream terraces. Some seem to be associated with incipient drainage systems on the edges of peatlands. They may occur on shallow organic deposits or deeper peats with some input of mineral sediment.

Soils: Bay Forests occur on a wide variety of organic soils and mucky Spodosols, with no prevailing type. Series mapped for examples include Murville (Umbric Endoaquod), Lynn Haven (Typic Alaquod), Roper (Histic Humaquept), Ponzer, Belhaven and Croatan (Terric Haplosaprists), Pungo and Dorovan (Typic Haplosaprists). They may represent inclusions in some of these map units.

Hydrology: Sites are permanently or semipermanently saturated. As in Pond Pine Woodland, the water table probably regularly drops to underlying mineral sediment during the dry season, allowing plant roots to reach it (Otte 1981). Water comes from rainwater and sheet flow. Most sheet flow is from pocosins, but there may be limited influx of less oligotrophic water from adjacent areas. Snyder (1980) suggested an association with the beginnings of streams draining outward from peatlands, and this appears to be true for many examples. Stream flooding is unlikely in those areas, but they may have slightly better drainage.

Vegetation: The vegetation is a woodland or forest with a canopy dominated by evergreen hardwoods. *Gordonia lasianthus* is usually most abundant and sometime strongly dominant. *Magnolia virginiana* and *Persea palustris* may be codominant or a minor component. *Nyssa biflora, Acer rubrum* var. *trilobum*, *Pinus serotina, Pinus taeda*, or *Chamaecyparis thyoides* may also be components. There is not usually a differentiated understory, and, if there is, it consists of the same species. The shrub layer usually is dense, though it may be more open under denser canopy. Besides shrub-size individuals of the canopy species, *Lyonia lucida, Ilex coriacea, Ilex glabra, Cyrilla racemiflora, Clethra alnifolia,* or *Leucothoe axillaris* are likely to be dense. Other shrubs may include *Vaccinium fuscatum*, *Vaccinium formosum, Aronia arbutifolia*, and *Morella caroliniensis*. *Smilax laurifolia* often forms dense tangles, and a few other vines, including *Toxicodendron radicans*, *Muscadinia rotundifolia*, and other *Smilax* spp. may be present. Herbs are generally sparse. *Anchistea virginica, Lorinseria areolata*, and *Sphagnum* spp. are most frequent, but *Osmundastrum cinnamomeum* and even *Neottia bifolia (Listera australis)* may occur.

Range and Abundance: Ranked G4. Bay Forests may occur wherever there are peatlands or peat-filled Carolina bays, but are not known to be present in most of them. They probably are sometimes overlooked and are presumed to be more abundant than the number of records indicates. Their abundance is also confused by use of the term "bay forest" for a wider range of vegetation (Pond Pine Woodland, Nonriverine Swamp Forest, Natural Lake Shoreline Swamp, and altered vegetation). The equivalent association ranges southward to Florida, and apparently is abundant in these other states.

Associations and Patterns: Bay Forests usually occur in association with Pond Pine Woodland and may also be associated with Peatland Atlantic White Cedar Forest or Nonriverine Swamp Forest. Many examples are associated with the beginnings of drainage channels on the edges of peatlands, grading into Cypress–Gum Swamp or Coastal Plain Small Stream Swamp downstream.

Variation: Examples vary with gradation to other communities. No variants are recognized.

Dynamics: The dynamics of Bay Forests are not well known. Various sources describe them as an end stage of succession for Peatland Atlantic White Cedar Forest, Pond Pine Woodland, or shrubby pocosins with the long absence of fire (Buell and Cain 1943; Kologiski 1977). Christensen (1988) suggests that shallow peat burns may allow *Chamaecyparis* or *Pinus serotina* establishment in Bay Forests. Many of these sources may be using the term more broadly, but it is a reasonable belief that the relatively shade-tolerant evergreen hardwoods, already present, would increase in the absence of natural disturbance. Trees that depend on catastrophic fire to regenerate, as *Pinus serotina* and *Chamaecyparis thyoides* do, would be succeeded by something else if they died out before a regenerating disturbance occurred.

However, field evidence for this is hard to find. Peatland Atlantic White Cedar Forest that does not regenerate before the trees die, or that has lost its trees through logging, tends to be invaded by pines or deciduous hardwoods, and more resembles Nonriverine Swamp Forest. Pond Pine Woodlands that are logged and do not regenerate usually remain shrub-dominated. Despite modern fire suppression, most large peatlands have burned well before the life span of *Pinus serotina*. Peatlands and Carolina bays that appear not to have burned since the era of modern fire suppression do not generally support Bay Forests in larger amounts than those that have burned. I have observed several cases where an intense fire killed *Pinus serotina* in a Pond Pine Woodland and sprouting of evergreen hardwoods led to their dominance of the succeeding forest — Bay Forest being created by disturbance rather than by absence of disturbance.

The vegetational composition of Bay Forests, often containing a few species not found in other Peatland Pocosin communities but shared with more minerotrophic wetlands, suggests that site and soil factors may be important in their occurrence.

Rare species:
Vertebrate animals: *Dendroica virens waynei.*

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